

be two pale belts : in my specimen there are a few grey scales on the portion of the wing corresponding to the interval between the first and second subbasal black belts in *P. antiphates*, as also on the interno-median area near the outer angle. The outer half of the second U-shaped mark, as also the submarginal band, is sap-green instead of white. The hind wing as in *P. nebulosus*. On the underside the fore wing is marked as in *P. nebulosus*, *i. e.* differs from the upperside in having the base, U-shaped markings, and submarginal band all of a deeper shade of green, and the inner margin, together with a large portion of the median area behind the third median nervule (in fact, just that portion of the wing which is covered by the hind wing when the insect is at rest with its wings closed over its back), ashy white. Hind wing as in Sikkim specimens of *P. antiphates*, except that the area between the middle and outermost black bands is thickly clouded, as if the bands bounding it had been "smudged" over it, with black scales; and the area beyond the discal series of rounded black spots is also more or less clouded with scattered black scales. The specimen therefore differs considerably from that upon which Butler has founded his *P. nebulosus*. In spite, however, of its many points of difference from *P. nebulosus*, and still more from *P. antiphates*, I am exceedingly averse to calling it a new species, being of opinion that it is, like the first-named species, only a melanoid variety of *P. antiphates*, or possibly rather a reversion to the primordial type of coloration of the entire *antiphates* group of *Papiliones*.

### XXXVIII.—*The Male Eels compared with the Females.*

By C. ROBIN\*.

THE existence of sexual differences in the common eel (*Muraena anguilla*, L., *Anguilla vulgaris*, Rafinesque, Rondelet) is open to no doubt, at whatever period of the year the examination is made.

With very few exceptions all the eels described under the varietal name of *pimpeneau* or *pimperneau*, from the maritime pools and marshes (*glut-eel* of English authors†), with large prominent eyes, a short flat muzzle, a slender cylindrical body,

\* Translated from the 'Comptes Rendus,' February 21, 1881, pp. 378-383.

† The broad-nosed eel, *Anguilla latirostris*, of Yarrell.

with the back black, and the pectoral fins a little larger than in the river-eels, not exceeding 0.38 or 0.40 metre &c., are males. In a lot of Seine eels, having all the ordinary characters, one 0.45 metre long, like most of the others, was a male. I have never found males of greater length.

Syrski gives 0.43 metre as the greatest length met with in the males that he observed.

The abundance of the *pimpeneaux* and their strongly marked characters may even lead us to say that there are few species of fishes in which the external sexual characters are so distinctive of the male in comparison with the female as in the Eels. Only the male does not quit the shores of the sea, except at the period of reproduction, to go to the bottom; whilst the female only goes to the sea, quitting the fresh water, temporarily and at the same period.

The dissection of eels 0.35 metre long, or thereabout, shows at the first glance, in all seasons, whether the animal is male or female. Instead of the well-known characters of the ovary, a continuous semitransparent ribbon, of a yellowish colour, folded like a frill, we see in the same place, with the same relations, the same differences of length to the right and left, and of diminution of breadth at the posterior extremity, the testis, a delicate narrow ribbon, more or less rose-coloured, or of a semitransparent grey tint, rarely whitish. It is formed of a series of flattened floating lobes, most frequently 2 millims. broad and of twice that length, the greatest thickness of which does not exceed 1 millim. out of the time of reproduction, with the inner surface convex and the other flat, the outer or free margin thin, rounded into a quadrant, the lobes all united at their base only by the deferent canal &c., and with independent and distinct lobules.

The peritoneal fold which envelops them, as is also the case with the ovaries, attaches them to the sides of the vertebral column and of the swim-bladder. In females of the same size it is a continuous ribbon, a centimetre or more in width, of a yellowish white colour, more or less opaque or semitransparent, that we find interposed in the same manner between the abdominal viscera and the corresponding portion of the ventral wall.

These differences between the male and female eel, perceptible at the first glance, are sufficient to enable them to be recognized; but it is necessary to ascertain them from the moment when there are males different from the *pimpeneau*, that is to say, having the external characters of the small or middle-sized females. These differences, moreover, are greater than those which exist between the ovary and the testis of the

*Muræna*\* and of various other fishes; they may even be compared with those which exist between the testes and the ovaries in the Batrachia and Birds.

But these external sexual differences are only sufficient because they correspond to structural dissimilarities existing between the constituent elements of the internal organs, fulfilling the physiological function of male on the one hand, of female on the other, and this in spite of morphological, embryogenic homologies and of connexions which approximate the ovary to the testis. This is what histology shows incontestably.

The want of this determination of the minute structure of these organs has caused people not to give to the external characters (those of the *pimpencau*, for example) the importance they possess as belonging here to the male, elsewhere to the female, with the body more swelled and not so black, the head more produced, the eye smaller, &c. This gap has even prevented some anatomists from taking count of the external differences which, at all seasons, exist between the ovary and the testis, the differences of structure of which are also always perceptible under the microscope.

On the one hand, at any period of the year, the ovary shows its ovules, more or less developed, but like those of all other osseous fishes, and its loose cellular tissue, which may be reduced to a minimum towards the period of oviposition, or, on the contrary, become in part cellulo-adipose subsequently; the ovary also always shows the narrow projections or thickenings of the surfaces of its lobes, parallel to each other, resembling folds running from the adherent to the free margin, and passing the latter in the form of small blunt denticulations.

On the other hand, the lobulate testis, of firmer consistence, with a close cellular texture, without adipose cells, traversed throughout its whole extent by *seminiferous* or *testicular tubes*, or *cylinders*, which are flexuous, twisted, terminated cæcally at both ends, at least out of the breeding-season—that is to say, falling into the type of *canaliculate testes*, such as that of the carps.

The contents of these tubes, which answer to what are called *spermatic capsules* in the case of other fishes, render the testis opalescent whitish grey, instead of the reddish-grey tint which is usual when its vessels are congested, a fact connected with the absence of ovules more or less rich in yellowish oily drops. These contents render the male organ more or less white, and

\* See C. Robin "Sur le cœur caudal des Anguilles," Journ. Anat. Physiol. 1880, p. 597.

make it pass into the state of *milt* at the time of the production of spermatozooids.

Out of the period of reproduction the seminiferous tubes are 0·08–0·09 millim. in thickness, cylindrical, twisted in various directions, and ramified once or twice. Some of them anastomose with their nearest neighbours. Their extremities are closed, rounded, with or without a slight inflation. For the most part one of the extremities is situated close to the surface of the organ, which is covered with a delicate peritoneal tunic. None of them is particularly directed towards the deferent canal, and none opens into the latter.

The flexuosities of the tubes, their volume, and their structure give to the tissue of the organ the characteristic arrangement and the aspect usually observed in the testicular tissue of the higher Vertebrata. It is only by an enormous dilatation at the breeding-season that we can imagine that these canaliculi arrive at the state of *seminal capsules*.

These tubes are immersed in a dense web of cellular tissue, without adipose vesicles, and of a thickness between the tubes about half that of the latter. The ramifications of the vessels coming from the base of the lobes run along by the tubes and form around each of their extremities, rounded at the surface of the organ, a circular mesh 0·08 millim. in breadth; these altogether constitute an abundant network. The examination of the entire lobe, before making thin sections, might lead one to suppose that these meshes circumscribe so many closed vesicles or seminal capsules, whilst we have to do only with the extremities of the seminiferous canaliculi.

By the assistance of Dr. Hermann, preparator of the course of histology of the Faculty of Medicine, I have been able to ascertain that these tubes are composed of a delicate proper wall (0·001 millim.), which is transparent and homogeneous, folds readily, and is strongly adherent to the exterior tissue. Their inner surface is uniformly lined with a single series of regularly prismatic epithelial cells, with their outer surface or base polygonal, which separate easily from the wall and are attenuated at their inner extremity. They bound, in the direction of the axis of the tube, a narrow canal, which is often apparently closed, in consequence of the contiguity of these extremities of the bounding-cells. The latter, which are finely granular, contain a comparatively large hyaline nucleus without granules, with a brilliant yellow nucleolus. The cells which are immediately contiguous are broken by separation, giving to the preparing fluid an opaline or lactescent appearance; floating in it are their shining yellowish granules and

their nuclei, which are set free, and may or may not become slightly irregular.

A deferent canal, about 1 millim. wide, with delicate walls, runs along the adherent inner or dorsal margin of each testis from one end to the other. These unite in a single cavity or *seminal vesicle* at the level of the cloaca. The seminal vesicle opens into the urethra by the genital pore, and by the urethra almost immediately into the cloaca. The wall of this spermiduct is at the utmost  $\frac{1}{3}$  millim. in thickness. It is composed of an inner layer of longitudinal, and an outer one of circular fibres; both of these, at the base of the lobes and a little upon their outer surface, entangle their bundles with those of the envelope of the male organ. These layers are formed of cellular tissue evidently mixed with smooth muscular fibres.

A single series of small polyhedric epithelial cells lines the inner surface of the deferent canal. Adherent to the inner border of all the delicate testicular lobules, it is thus lodged within the peritoneal fold attaching the testis to the swimming-bladder and the upper part of the abdominal walls.

As will be seen, with regard to the determination of the male sex of the Eels, we had to compare the well-known female generative organs with their homologues in the numerous individuals or groups of individuals which have external characters somewhat different from those of the most widely-distributed of these fishes.

The absence of ova in the one set, their presence at all times in the others,  $\frac{1}{10}$  to  $\frac{2}{10}$  millim. in diameter, so easily ascertained, might have furnished a demonstration, even without the comparison of the structure of the organ without ovules with the testis of other fishes.

These comparisons ought certainly to have been made before any investigation tending to prove the existence of an exceptional hermaphroditism, or indeed before imagining, without any previous study of the evolution of the ovary, that the organ described as the testis is only an ovary which has not arrived at its complete development.

The testicular structure in the organ of certain eels which is the homologue of the ovary of the others being incontestable, all that has been said, even within the last few years, of this hermaphroditism, and of the resemblance in this particular between the Eels and the Serranidæ, need no longer be discussed.

We may add that in the *Muræne* (*M. helena*, L.) the generative organs constitute no exception to what they are in other osseous fishes. The males of the Congers, or rather the place of their ordinary sojourn, alone remain to be discovered.



The sex being ascertained, the general facts regarding the reproduction of these Apodal fishes follows therefrom; and these facts do not differ from what they are in nearly all other fishes, the Salmons in particular. Only the propagative migration of the Eels taking place from the fresh waters to the sea, the mode in which oviposition is effected, the fecundation and hatching of the ova, are still unknown. The Salmons, behaving in a directly opposite fashion, we have been able, so far as they are concerned, to study and utilize all these physiological peculiarities.

The same causes have hitherto prevented our seeing the testes of the Eels as they are at their arrival at the state of *milt*, and observing their spermatozoids, notwithstanding the abundance of the males (or *pimpeneaux*). But the period of the descent of the females towards the sea (November) shows that it is in November and December that they ought to be studied. These, however, are the only two months during which I have as yet been unable to observe them. I have ascertained that in October there are as yet no fecundating elements, and that in January there are no longer any. In the Landes and other parts of the south no doubt, the ascent of the young fish taking place as early as the second half of December, instead of in March, as in the Channel, these investigations will have to be made as early as September or October. As to the return of the females from the sea to the fresh waters, this cannot be denied; in fact I have received from M. Dufourcet some female eels of the variety *sardias*, taken in January and February in the Adour at about 40 kiloms. from the sea, one half of which had the stomach filled with examples of *Eunice sanguinea* and *Doris*, which are exclusively marine invertebrates.

Except as regards the minute structural determination and the truly testicular nature of the organ homologous with the ovaries, the preceding anatomical data are not new. The want of this determination and of the observation of the spermatozoids is probably what has led to their not having hitherto been taken into consideration as they deserve to be.

Duvernoy (Cuvier, Anatomie Comparée, ed. 2, 1846, tome viii. p. 117) describes the ruffle-like type of the testis of the Lampreys and Eels, with the free margin festooned in lobules, shorter to the right than to the left, like the ovaries, &c. He adds:—"At the breeding-season we perceive in it an innumerable quantity of granulations or small spermatie capsules, the rounded form of which has often led to their being confounded with the ovules, at least in the Eels, in which, in reality, these capsules are of nearly the same size as

the ovules; but the latter are distinguished by their oval form." The ovules are spherical, and not oval; but the other facts are fundamentally correct. It is also in error that Duvernoy adds (p. 133):—"The Eels and the Lampreys have no deferent canal, any more than an oviduct. Like the ova, their semen ruptures the capsules in which it has collected, and diffuses itself in the abdominal cavity, whence it is expelled in the same way as the ova." But he correctly describes the place of opening of the peritoneal canal, the ureters, &c.

Valenciennes thought that the external characters regarded as serving to establish specific division among the common Eels might be due to difference of sex, and that, for example, the *pimpeneau* (*glut-eel* of the English) was the male of the *plat-bec* (*grig-eel* of the English). Nevertheless he did not venture to assert that such was the case (Dict. d'Hist. Nat. 1867, tome i. p. 548).

Syrski (Sitzungsab. Akad. Wiss. zu Wien, Bd. lxxix. 1874) has described and figured the homologies between the flattened lobulated testes of the Eels and their ovaries, the absence of ovules in the former coexisting with their presence in the latter. He particularly made known the deferent canal and its cloacal opening, but without determining the characteristic testicular structure of the lobules.

Lastly, Dareste ('Comptes Rendus,' 1875, tome lxxxi. p. 159) fully confirmed these observations upon the *pimperneaux* as regards the external anatomical character of the male organ. Among the *pimperneaux* he notices some female individuals. The Indian *Anguilla marmorata* also furnished him with males.

XXXIX.—*On a Collection of Nocturnal Lepidoptera from the Hawaiian Islands.* By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Continued from p. 333.]

### Tortricidæ.

#### CHILOIDES, gen. nov.

*Pædiscæ* affine genus; differt autem palpis longioribus infra bene ciliatis, ciliis antice productis; capite piloso. Alæ posticæ ramis secundo et tertio medianis bene separatis, petiolo nullo.

This genus has the form and general aspect of *Pædisca*, with which it seems to agree in the neuration of the prima-